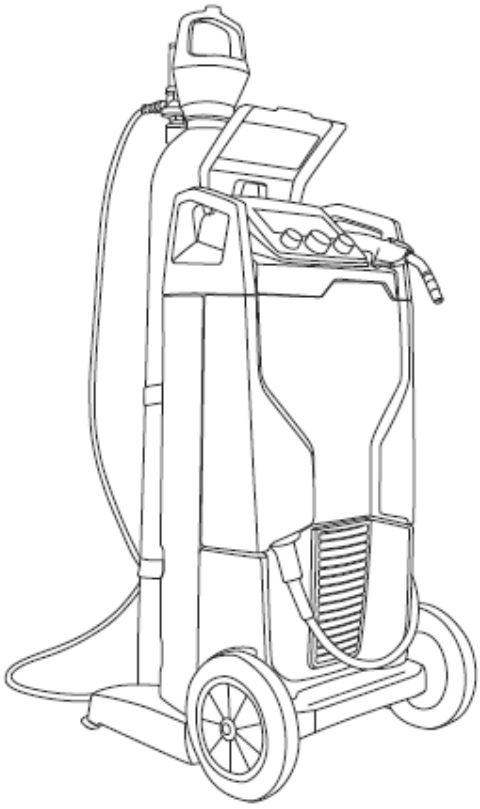
SERVICE MANUAL
KEMPACT RA



181A
251R/251A
253R/253A
323R/323A

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General

Kempact RA(Regular / Adaptive) welding machines are compact MIG/MAG welding machines designed for professional use.

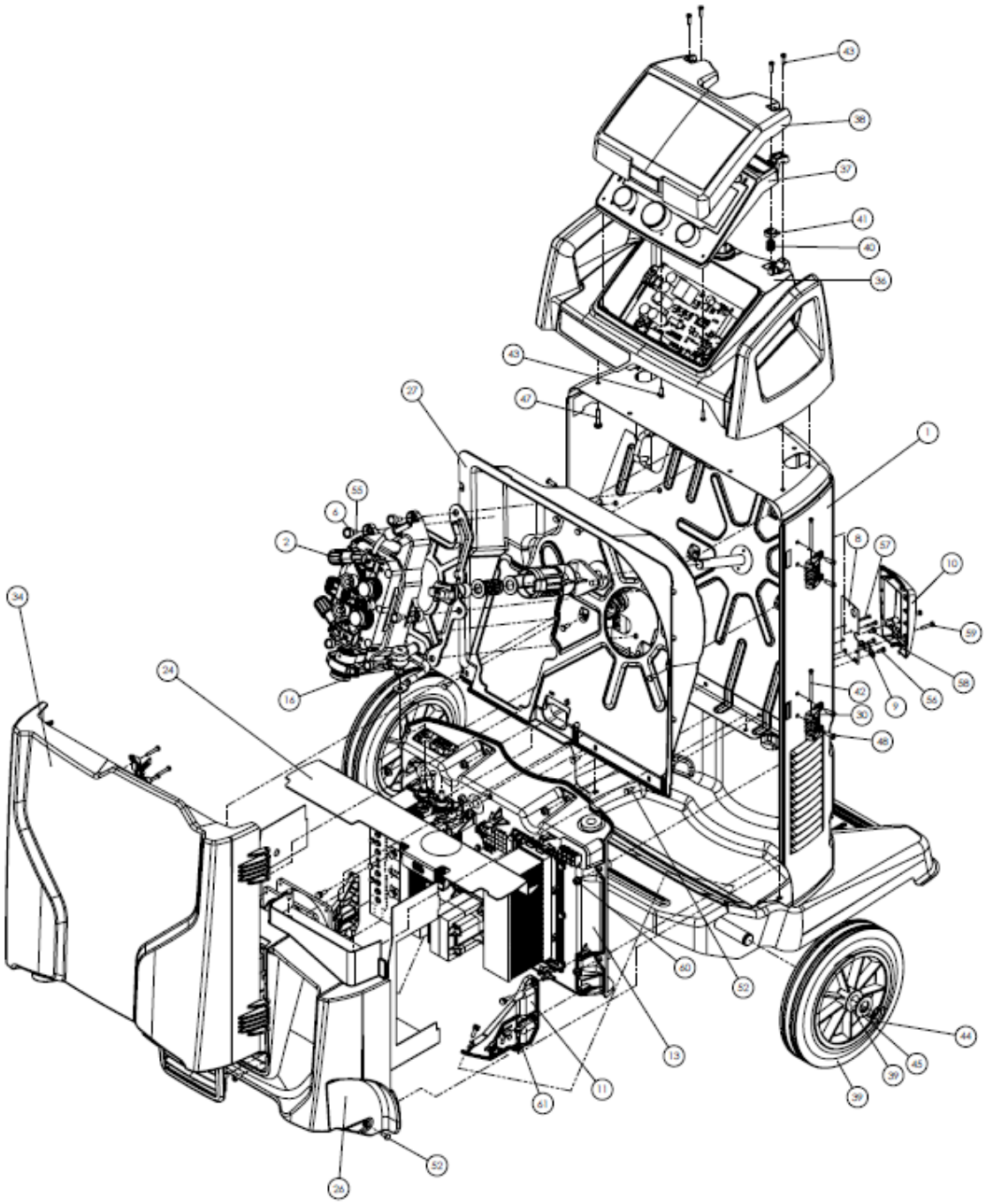
The power source part of the machine is based on inverter technology. IGBTs are used as power switches in the inverter. Kempact RA welding machines also contain all circuitry that is needed to drive wire feeder part of the machine and also easy to use intuitive user interface. Most of the welding machine functions are controlled using a microcontroller.

Before removing any covers or commencing any testing or measurement disconnect the power source from the mains voltage. Dangerous DC voltage may still exist after the removal of the input voltage. Machine discharges the voltage while it is turned off, but it is always better to ensure this by measuring the voltage.

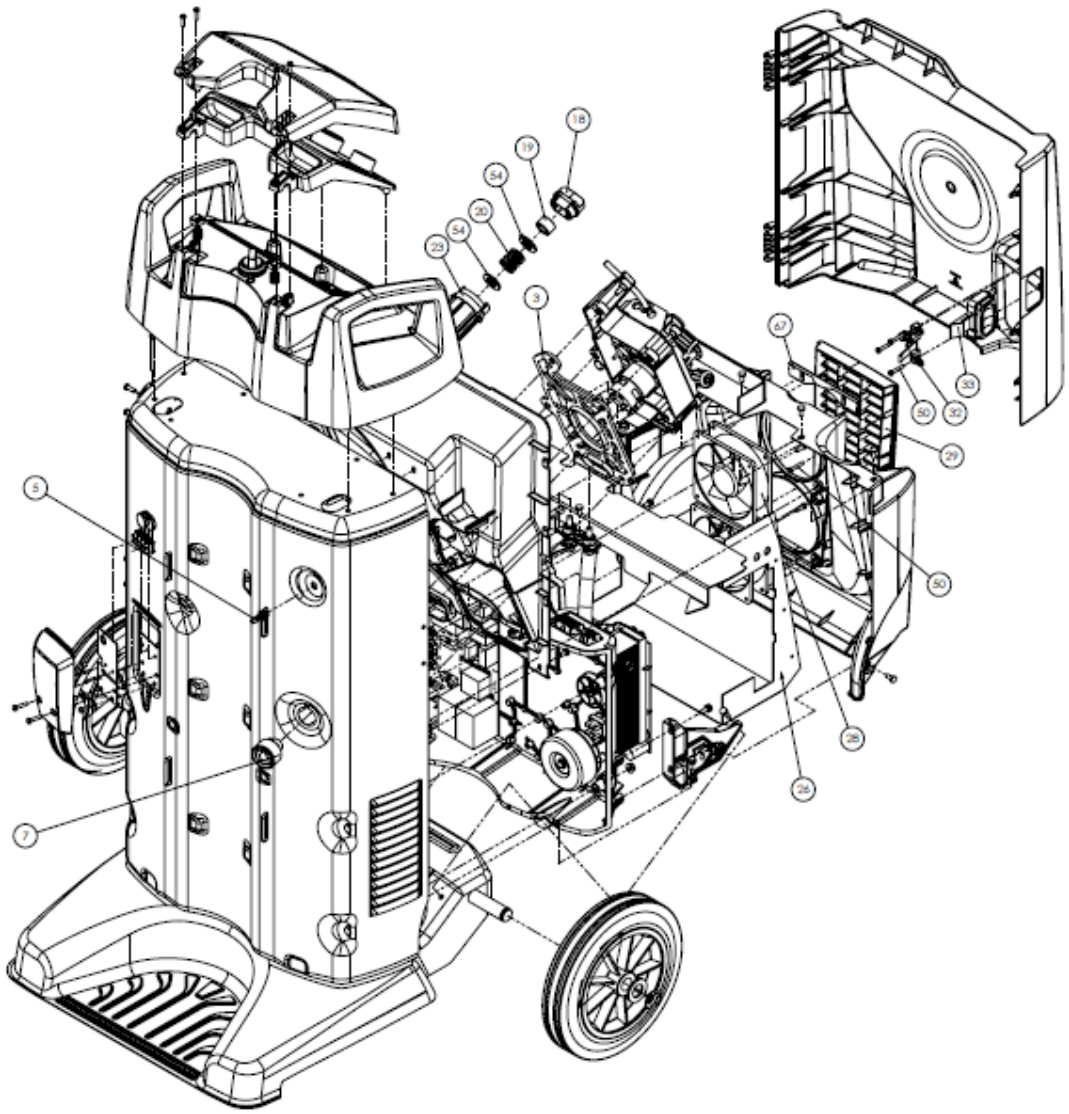
Digital multimeters may give different values depending the specifications they have. For example diode measuring values may vary between the multimeters models. Special attention must be considered while working with the internal parts.

The device may be repaired only by a person legally authorized to perform electrical work.

1. PARTS OF MACHINE



Kempact RA (253, 323)



Kempact RA (253, 323)

ITEM CODE	PART	ITEM DESCRIPTION	PCS	QTY
W005603	1	FRAME WA KEMPACT RA	1	1
W005926	2	KEMPACT RA 3PH WF ASSEMBLY DT400 RI	1	1
W005791	3	KEMPACT WF MOUNTING FRAME INSULATOR	1	1
W006602		SOLENOID VALVE Kempact RA	1	1
9568913	5	HOSE CONNECTOR R1/8-6ML	1	1
W004288	6	INSULATION BUSHING	5	1
9771530	7	WELD CONNECTOR DIX 50 FEMALE	1	1
W005782	8	TERMINAL BLOCK INSULATING PLATE 3PH	1	1
9792639	9	CABLE CLAMP	1	1
W005779	10	TERMINAL BLOCK COVER KEMPACT RA	1	1
W006130	11	ANGLE SUPPORT RIGTH KEMPACT RA	1	1
W006128	12	ANGLE SUPPORT LEFT KEMPACT RA	1	1

W006215	13	COMPONENT FRAME ASSEMBLY KEMPACT RA	1	1
W006154		POLARITY CABLE TO DIX KEMPACT RA	1	1
W006153		POLARITY CABLE TO ADAPTER KEMPACT	1	1
W006429	16	POLARITY PROTECTION 25 MM2 MINUS	1	1
W003701		POLARITY PROTECTION 25 MM2 PLUS	1	1
3133500	18	LATCH FOR SPOOL HUB	1	1
4265820	19	SPECIAL NUT M16X1	1	1
4270940	20	PRESSURE SPRING HUB	1	1
4267970	54	BRAKE PAD	1	1
2062070	23	WIRE SPOOL HUB	1	1
W005661	24	PARTITION WIND PLATE KEMPACT RA	1	1
W006115	26	AIR GUIDE PLATE KEMPACT	1	1
W005790	26	LOWER COVER KEMPACT RA	1	1
W005041	27	SPOOL CASING COVER KEMPACT RA	1	1
W002918	28	FAN	2	1
W005793	29	LOWER GRILL KEMPACT RA	1	1
W005872	30	HINGE KEMPACT RA	2	1
W005821	32	LATHC LOCK KEMPACT RA	1	1
W005813	33	LATCH KEMPACT RA	1	1
W006249	34	DOOR WITH MARKING KEMPACT RA	1	1
W006176	36	PANEL BASE ASSY 3PH KEMPACT RA	1	1
W006208	37	PANEL FRAME ASSEMBLY KEMPACT R	1	1
W005918	38	PANEL COVER KEMPACT RA	1	1
W006392	40	PANEL COVER SPRING KEMPACT RA	2	1
W006180	41	HINGE PIN KEMPACT RA	2	1
9449407	43	PT-SCREW 4X16 WN1452 TX20 ZN BLPAS	4	1
9441047	47	ZN MPASSOCKET HEAD CAP SCREW M5X16 BN1206	4	1
9547150	39	CASTOR 250/50-20/60 MM	2	1
9476520	44	CIRCLIP 15X1.5 DIN 6799	2	1
9420120	45	WASHER M20 DIN 125 A ZN	4	1
W001624	48	SQUARE NUT M5 DIN 557	2	1
9449461	50	PT-SCREW 5X14 WN1452 TX20 ZN BLPAS	8	1
9449233	52	ZN MU SELF-TAPPING SCREW TX25 M5X16 DIN7500CE Z1N BLAC1K	7	1
9433024	55	TORX SCREW M4X10 DIN7985 T20 ZN BLACK	2	1
9433007	56	TORX SCREW M3X20 DIN7985 T15 ZN BLACK	2	1
9433043	57	TORX-SCREW M5X8 DIN7985 T25 ZN BLACK	2	1
9433027	58	TORX SCREW M4X20 DIN7985 T20 ZN BLACK	2	1
9410250	59	FLANGE NUT DIN6923 M6	6	1
9432824	60	14583 TX DIN6900-3	8	1
9410108	61	HEX NUTM8 DIN 934-8 ZN	2	1
W006603	67	FILTER MOUTH COVER KEMPACT RA	1	1
9425216		INTERNAL TAB WASHER D16 DIN 462 ZN	1	
9592164		BOTTLE FASTENING BAND KEMPACT RA	2	
W006222		CODING WIRE KEMPACT RA	1	
4292020		HOSE	1	
6184211T		GROUNG CABLE 25-5	1	
4262810		FLAT CABLE L = 175	1	
W006201		KEMPACT 253R PRODUCT LABEL	1	
W006234		RATING PLATE KEMPACT 253 R	0	
W005681		MAIN CIRCUIT DIAGRAM KEMPACT RA 253 323	0	
4252013		CONNECTOR 4 X 1.5MM2-5M	1	
9840486		FOAMED PLASTIC SHEET 2MM	1	0.5 M2

NOTE !
More info available from: spareparts@kemppi.com (email).

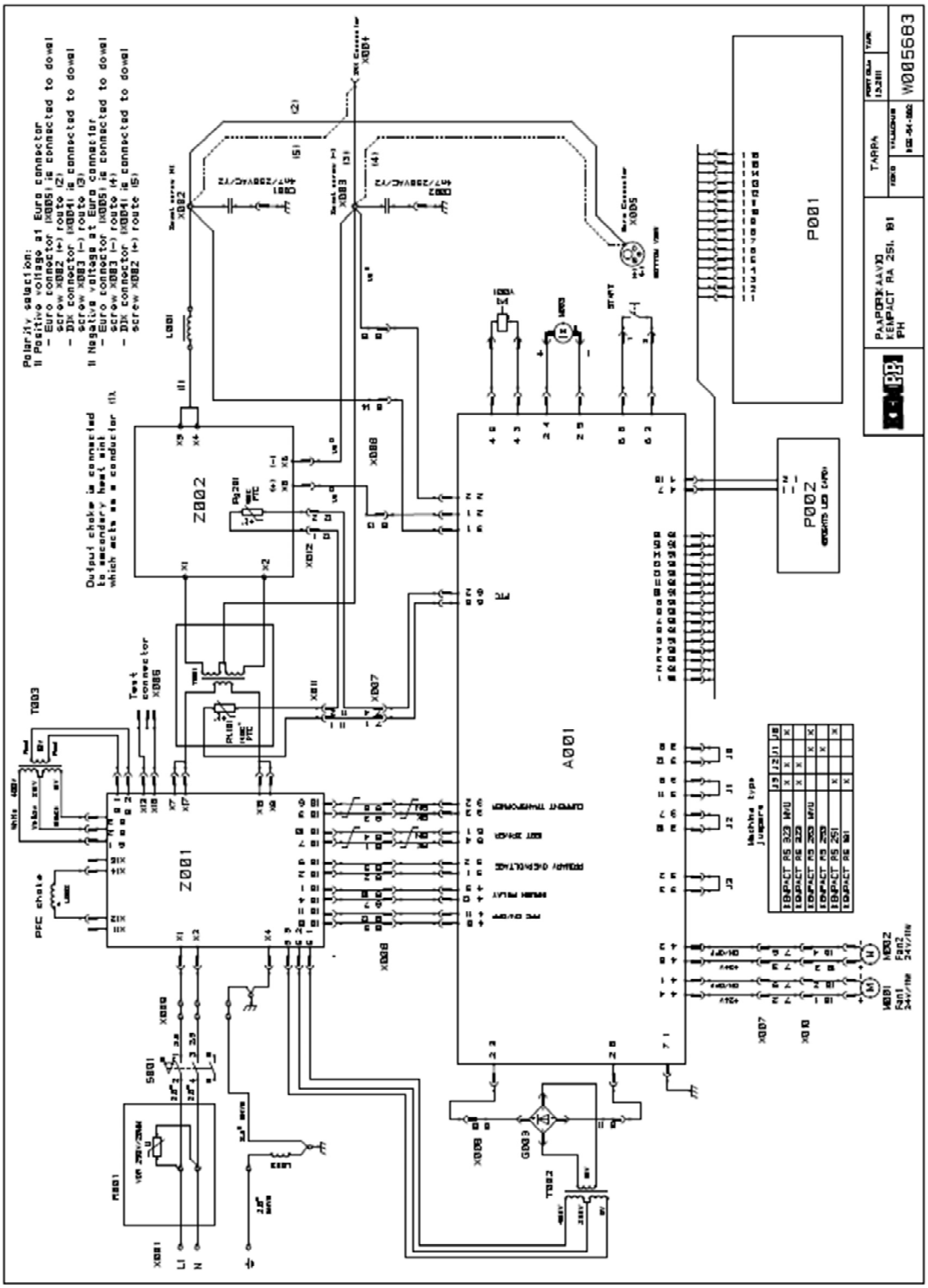
2. TECHNICAL INFORMATION

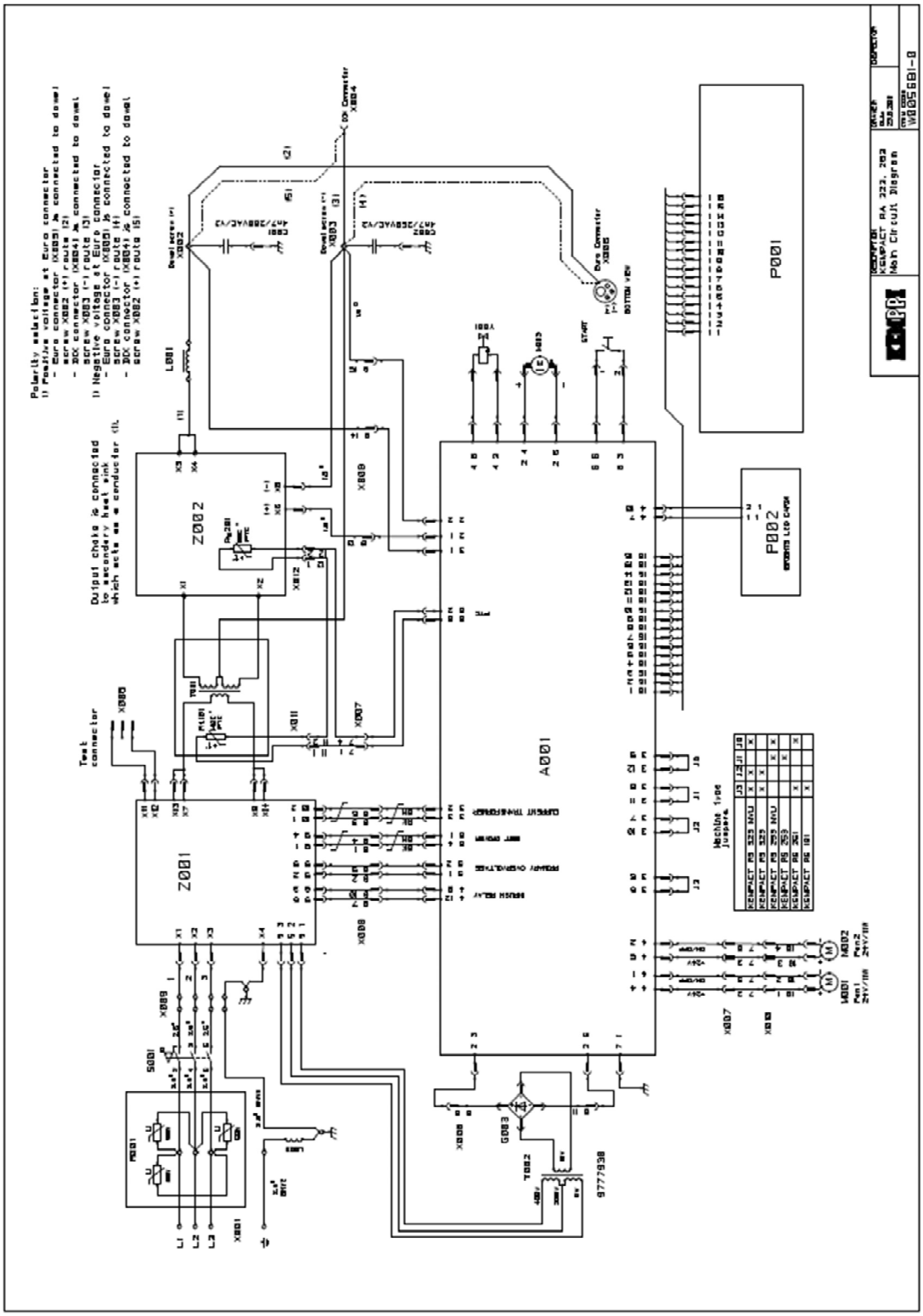
2.1. Technical data

	Kempact 181A		Kempact 251R, 251A	
Connection voltage	50/60Hz	230V+- 15% 1~	50/60Hz	240V+- 15% 1~
Rated power at max. current	50% ED I1max (180A)	5.16VkA/5.1kW	30% ED I1max (250A)	8.5kVA/8.4kW
Supply current	50% ED I1max (180A)	22A	30% ED I1max (250A)	36A
	100% EDI1eff (140A)	16A	100% EDI1eff (150A)	17A
Connection cable	H07RN-F	3G1.5 (1.5mm2, 5m)	H07RN-F	3G2.5 (2.5mm2, 5m)
Fuse	Type C	16A	Type C	20A
Welding range		10V/20A - 26V/180A		10V/20A - 29V/250A
No load voltage		36V		36V
Idle power		35W		35W
Power factor at max.	180A/25,75V	0.99	250A/26.5V	0.99
Efficiency at 100% ED	140A/21V	0.82	150A/21.5V	0.82
Wire feed speed adjustment range		1.0-14.0m/min		1.0-18.0m/min
Voltage adjustment range		8.0-26.0V		8.0-29.0V
Filler wires	Fe solid	0.8…1.2 mm		0.8…1.2 mm
	Fe cored wires	0.8…1.2 mm		0.8…1.2 mm
	Ss	0.8…1.2 mm		0.8…1.2 mm
	Al	1.0…1.2 mm		1.0…1.2 mm
	CuSi	0.8…1.0 mm		0.8…1.0 mm
wire spool	max	300 mm/ 20 kg		300 mm/ 20 kg
Shielding gases		CO2, Ar, Ar+CO2 mixed		CO2, Ar, Ar+CO2 mixed
External dimensions	LxWxH	623x579x1070 mm	LxWxH	623x579x1070 mm
Weight	Not including gun and gables	44 kg	Not including gun and gables	44 kg
Temperature class		F(155 C)		F(155 C)
EMC class		A		A
Degree of protection		IP23S		IP23S
Operating temperature range		-20…+40 °C		-20…+40 °C
Storage temperature range		-40…+60 °C		-40…+60 °C
Standards		IEC 60974-1		IEC 60974-1
		IEC 60974-5		IEC 60974-5
		IEC 60974-10		IEC 60974-10
		IEC 61000-3-12		IEC 61000-3-12

	Kempact 253R, 253A		Kempact 323R, 323A	
Connection voltage	50/60Hz	400V+- 15% 3~	50/60Hz	400V +- 15% 3~
Rated power at max. current	40% ED I1max (250A)	8.34kVA/7.73kW	35% ED I1max (320A)	12kVA/11.3kW
Supply current	40% ED I1max (250A)	11.9A	35% ED I1max (320A)	17.2A
	100% EDI1eff (150A)	6.1A	100% EDI1eff (190A)	8.2A
Connection cable	H07RN-F	4G1.5 (1.5mm2, 5m)	H07RN-F	4G1.5 (1.5mm2, 5m)
Fuse	Type C	10A	Type C	10A
Welding range		10V/20A - 31V/250A		10V/20A - 32.5V/320A
No load voltage		41V		45V
Idle power		25W		25W
Power factor at max.	250A/26.5V	0.93	320A/30V	0.94
Efficiency at 100% ED	150A/21.5V	0.88	190A/23.5V	0.86
Wire feed speed adjustment range		1.0-18.0m/min		1.0-20.0m/min
Voltage adjustment range		8.0-31.0V		8.0-32.5V
Filler wires	Fe solid	0.8…1.2 mm		0.8…1.2 mm
	Fe cored wires	0.8…1.2 mm		0.8…1.2 mm
	Ss	0.8…1.2 mm		0.8…1.2 mm
	Al	1.0…1.2 mm		1.0…1.2 mm
	CuSi	0.8…1.0 mm		0.8…1.0 mm
wire spool	max	300 mm/ 20 kg		300 mm/ 20 kg
Shielding gases		CO2, Ar, Ar+CO2 mixed		CO2, Ar, Ar+CO2 mixed
External dimensions	LxWxH	623x579x1070 mm	LxWxH	623x579x1070 mm
Weight	Not including gun and gables	44 kg	Not including gun and gables	44 kg
Temperature class		F(155 C)		F(155 C)
EMC class		A		A
Degree of protection		IP23S		IP23S
Operating temperature range		-20…+40 °C		-20…+40 °C
Storage temperature range		-40…+60 °C		-40…+60 °C
Standards		IEC 60974-1		IEC 60974-1
		IEC 60974-5		IEC 60974-5
		IEC 60974-10		IEC 60974-10
		IEC 61000-3-12		IEC 61000-3-12

2.2. Main circuit diagrams





3. DESCRIPTION OF OPERATIONS

Kempact RA welding machine consists of several circuit cards and separate components. In the following sections are described the main components and separate cards functions.

Machine basic function (machine start up), after mains voltage is switched on:

1. DC-link capacitors are charged and if there is no over voltage condition inrush relay is switched on after a short delay
2. If there is PFC circuit it's enabled after a short delay
3. Fans are started for a test run after a short delay
4. Welding is enabled

Kempact RA machines have following parts and components:

- Terminal block X001
- Varistors R001
- Main switch S001
- Terminal block X009
- Main circuit card Z001
    - EMC filter
    - Inrush current limiting
    - IGBT driver
    - Current transformer T1
    - Main circuit
- PFC choke (181-, 251-models)
- PFC circuit auxiliary transformer T003 (181-, 251-models)
- Test connector X006
- Auxiliary transformer T002
- Rectifier bridge G003
- Control card A001
- Cooling fans M001 and M002
- Gas valve Y001
- Wire feed motor M003
- Brights led card P002
- Panel card P001
- Main circuit card Z001
- Secondary rectifier card Z002
- Secondary choke L001
- Output RFI filters C001 and C002
- Euro connector X005

3.1. Main components

3.1.1. Terminal block X001

- Mains cable is connected to the terminal block X001. The terminal block is located in the mains cable connection box on the back plate of the machine. Also varistors R001 are connected to this terminal block. From the terminal block mains voltage is wired to main switch S001

3.1.2. Varistors R001

- The varistors are located in the mains cable connection box on the backside of the welding machine
- The purpose of the varistors is to protect the welding machine against voltage spikes coming from the mains

3.1.3. Main switch S001

- The main switch is located in the upper part of the machine close to the user interface

3.1.4. Terminal block X009

- From the main switch S001 mains voltage is wired to terminal block X009 which is located on the front side of the component frame. From this terminal block mains voltage is wired to the main circuit card Z001
- PE (protective earth) is wired from this terminal block into the component frame and connected to a chassis ground terminal

3.1.6. Test connector X006

- Possible to measure DC-link voltage during service

3.1.7. Auxliary transformer T002 and rectifier bridge G003

- Auxliary transformer is a 60VA toroidal transformer
- It has 230V and 400V inputs and 18V output
- 230V input is used in 181 and 251 machines
- 400V input is used in 253 and 323 machines
- Auxliary transformer output voltage is rectified using rectifier bridge G003. Both the auxiliary transformer and the rectifier bridge are located inside the component frame

3.1.8. Control card A001

3.1.8.1. Auxiliary power supply

- Auxliary voltage +24V is used by fans, gas valve, inrush relay and brights LED. This voltage is also used to drive opto-coupler that enables PFC and panel backlight. To generate +24V voltage auxliary transformer T002 output is full wave rectified using rectifier bridge G003
- Auxliary voltage +15V is used by IGBT driver (V20, V22, V23, V25 etc.), PWM IC (N5), motor control half bridge driver (N2) and other circuits
- Auxliary voltage +5V is used by microcontroller N7, panel card P001 and other circuits

3.1.8.2. Microcontroller

- Many of the control card A001 functions are using the microcontroller N7. Basic functions of the microcontroller include controlling output voltage of the inverter. The microcontroller measures output voltage and changes peak current reference of the inverter to regulate it
- The microcontroller also regulates wire feed speed by setting motor current reference and measuring EMF of the motor

3.1.8.3. Motor control

- Wire feed motor control is based on EMF (electro magnetic force) measurement principle
- Wire feed mechanism doesn't have tachometer, instead motor current is driven to zero every ca. 10ms and the EMF of the motor is measured before motor current is increased again. This EMF information is then used to regulate motor speed
- The microcontroller measures motor EMF and controls motor current to regulate motor speed

3.1.8.4. PWM

- PWM (pulse width modulation) circuit is for controlling the inverter
- Peak current-mode control is used to directly control primary current which is measured by current transformer T1 l

3.1.9. Fans M001, M002

- Machine fans are controlled by the control card A001 microcontroller. If there are two fans (3~models) in the machine they are started in sequence so that second fan is started after 3s delay. When welding starts fans are started and when welding stops fans are stopped after post run time
- In error situation fans are always on
- Fans are stopped if arc is not established during first 5s after start

3.1.10. Solenoid valve Y001

- Solenoid valve is controlled by control card A001 auxiliary voltage + 24 V

3.1.11. Wire feed motor M003

- Wire feed motor control is based on EMF (electro magnetic force) measurement principle. Wire feed mechanism doesn't have tachometer, instead motor current is driven to zero every ca. 10ms and the EMF of the motor is measured before motor current is increased again. This EMF information is then used to regulate motor speed. Wire feed motor speed control is done using the microcontroller. The microcontroller measures motor EMF and controls motor current to regulate motor speed
- There is no special wire inch button. Wire inch is started like normal welding using the gun. When the user pushes start button wire feed motor and the power source start. Wire feed speed is creep start speed which is slower than normal wire feed speed. If arc is not established during first 5s the power source is shut down but wire feeding continues with creep start speed for 30s. When the inverter is ON operating voltage for the wire feed motor is taken from the output of the power source. When the inverter is SHUT DOWN after 5s operating voltage for the wire feed motor is taken from the auxliary transformer for safety reasons. Because of this current limit of the wire feed motor has to be lowered. For this reason also torque of the wire feed motor is reduced after 5s

3.1.12. Brights led card P002

- Controlled by control card A001 auxiliary voltage + 24 V

3.1.13. Panel card P001

- There is two panel versions R and A (R-version has limited functions). Panel is connected to the control card A001 with 16-wire ribbon cable
    - When machine start up panel is showing power source size and SW version

3.1.14. Main transformer T001

- In the 181 and 251 machines the main transformer has 19 turn primary winding and center tapped secondary 2 + 2 turns (turns ratio 9.5:1)
- In the 253 machine the main transformer has 27 turn primary winding and center tapped secondary 2 + 2 turns (turns ratio 13.5:1)
- In the 323 machine the main transformer has 25 turn primary winding and center tapped secondary 2 + 2 turns (turns ratio 12.5:1)

3.1.15. Secondary rectifier card Z002

- Z002 is used to rectify the secondary current. There are 4 60A diodes connected in parallel in both legs of the rectifier (V1 – V8) in 323 power source. 250 amps machine has 3+3 diodes
- Capacitors C1 and C2 and resistors R3 and R4 form a snubber circuit. The snubber circuit reduces the voltage stress of the diodes caused by the reverse recovery current snap off
- Varistors R1 and R2 are for TIG ignition spark protection
- Operating voltage for the wire feed motor is rectified to capacitors C3-C5

3.1.16. Secondary choke L001

- The secondary choke L001 reduces ripple content of the secondary current

3.1.17. Output RFI filter C001, C002

- Capacitors C001 and C002 connected to the dowel screws (+ and -) reduce radio frequency interference

3.1.18. Output terminal X004

- Dix connector X004

3.1.19. Euro connector X005

3.2. Main circuit diagram 181-, 251-models

- 181 and 251 machines have many common technical details with 253 and 323 machines. They have e.g. the same P001, P002 and Z002 cards. Main differences to 253 and 323 machines are described here

3.2.1. PFC Choke L002

181 and 2511 machines include PFC (Power Factor Correction) circuit. This is implemented using boost topology. The Boost topology has choke in the input side of the converter. In Kempact 181 and 251 this choke is located on the front side of the component frame from where it is wired into the component frame

3.2.2. PFC circuit auxiliary transformer T003

PFC circuit auxiliary power is generated using small toroidal transformer located inside the component frame

3.2.3. Main circuit card Z001

3.2.3.1. EMC Filter

- Capacitors C7, C10, C15, C16 and inductor T6 form an EMC filter. The purpose C17 and R18 is to dampen common mode transients coming from mains

3.2.3.2. Inrush current limiting

- PTC resistors R16 and R17 limit inrush current when the power source is switched on. PTCs are bypassed with relays K1 and K2 after DC link capacitors have been charged. Relays K1 and K2 are controlled by the microcontroller

3.2.3.3. IGBT driver

- IGBT driver consists of gate transformers T2 and T3 and surrounding components

3.2.3.4. Current transformer T1

- Current transformer T1 is monitoring primary current and stops power stage operation if current is raising too high

3.2.3.5. Main circuit

- The main circuit consists of boost type PFC circuit followed by H-bridge type converter.
- Both parts of the main circuit are implemented using the same 600V, 75A six pack IGBT module
- One leg of the IGBT module is used for the Boost PFC circuit. Lower IGBT is used as the Boost power switch and the anti-parallel diode of the upper IGBT as the boost diode
- The switching frequency of the boost circuit is ca. 15 kHz. The boost circuit raises DC link voltage to ca. 370V. Boost input current is measured using shunt resistors R58, R59, R65, R66. H – bridge is implemented using the other two legs of the IGBT module

3.2.3.6. PFC Boost control circuitry

- PFC control circuitry is located on the primary side. Auxliary transformer T003 supplies operating voltage for the PFC control circuitry. The output voltage of the T003 is first rectified and then linear regulator is used to regulate auxiliary voltage to 15V. PFC control IC N1 regulates DC-link voltage to approximately 370V

3.3. Main circuit diagram 253-, 323-models

3.3.1. Main circuit card Z001

3.3.1.1. EMC filter

- Capacitors C5 - C7, C8 - C10, C19 - C21 and inductors T4 and L1 form an EMC filter
- First part of the filter is three phase filter which is located before the three phase rectifier V2
- Second part is DC filter (L1) which is located after three phase rectifier

3.3.1.2. Inrush current limiting

- PTC resistor R1 limits inrush current when the power source is switched on
- R1 is bypassed with relays K1 and K2 after DC link capacitors C17, C18 have been charged
- Relays K1 and K2 are controlled with the microcontroller

3.3.1.3. IGBT driver

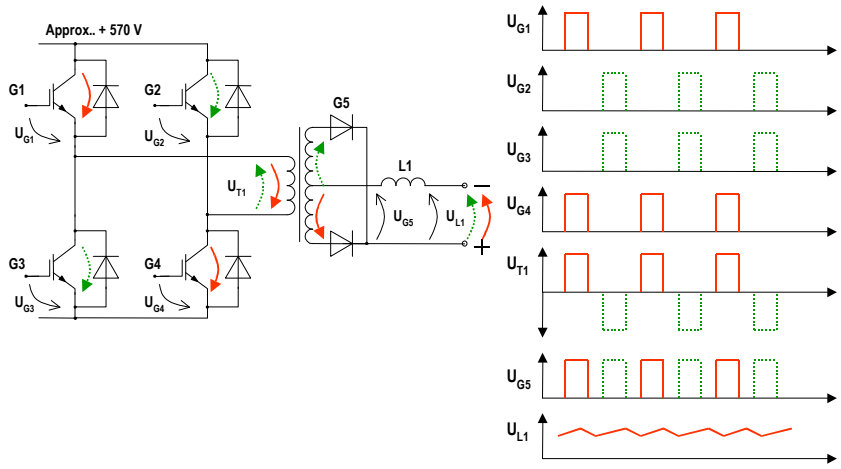
- IGBT driver consists of gate transformers T2 and T3 and surrounding components

3.3.1.4. Current transformer T1

- Current transformer T1 is monitoring primary current and stops power stage operation if current is raising too high

3.3.1.5. Main circuit

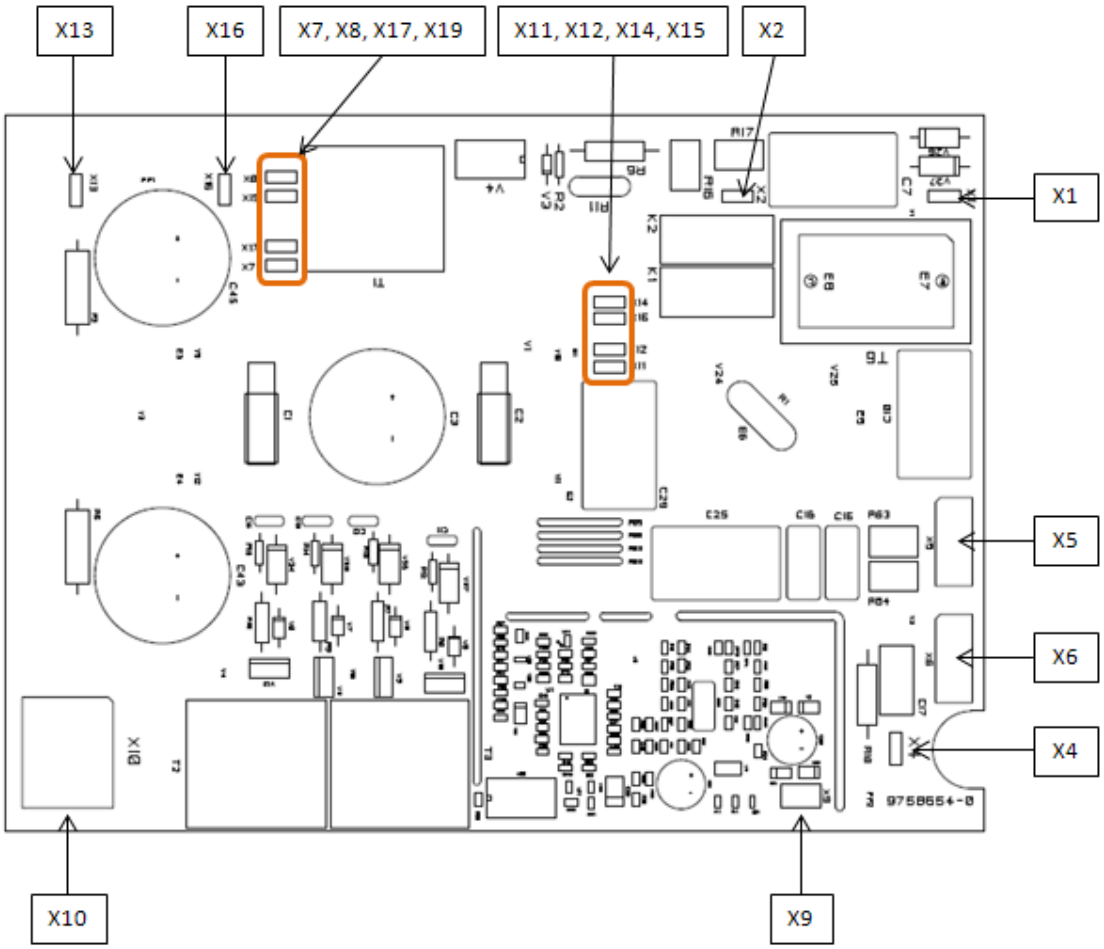
- Main circuit topology is H-bridge. The H-bridge topology requires four power switches which are implemented using IGBT module V2. The switching frequency of the H – bridge is 20 kHz
- 253 power source uses 50A module
- 323 power source uses 75A module



When IGBT-transistors **G1** and **G4** conduct, there is a positive voltage $\mathbf{U_{T1}}$ in main transformer **T1** primary and when IGBT-transistors **G2** and **G3** conduct there is a negative voltage $\mathbf{U_{T1}}$ in main transformer primary. Power is adjusted by changing the IGBT timings (PWM).

4. MAIN CIRCUIT CARD Z001

4.1. Kempact 181, 251



4.1.1. Connectors

Pin	Signal	Description
X1	Mains voltage	Main voltage connector
X2	Mains voltage	Mains voltage connector

Pin	Signal
X4	Chassis ground connector

Pin	Signal
X5	Auxiliary transformer connection, auxliary transformer is protected with PTC resistors R63 and R64
X6	PFC Auxiliary transformer connection, auxliary transformer is protected with PTC resistors R63 and R64

Pin	Signal
X7	Main transformer connections
X8	Main transformer connections
X17	Main transformer connections
X19	Main transformer connections

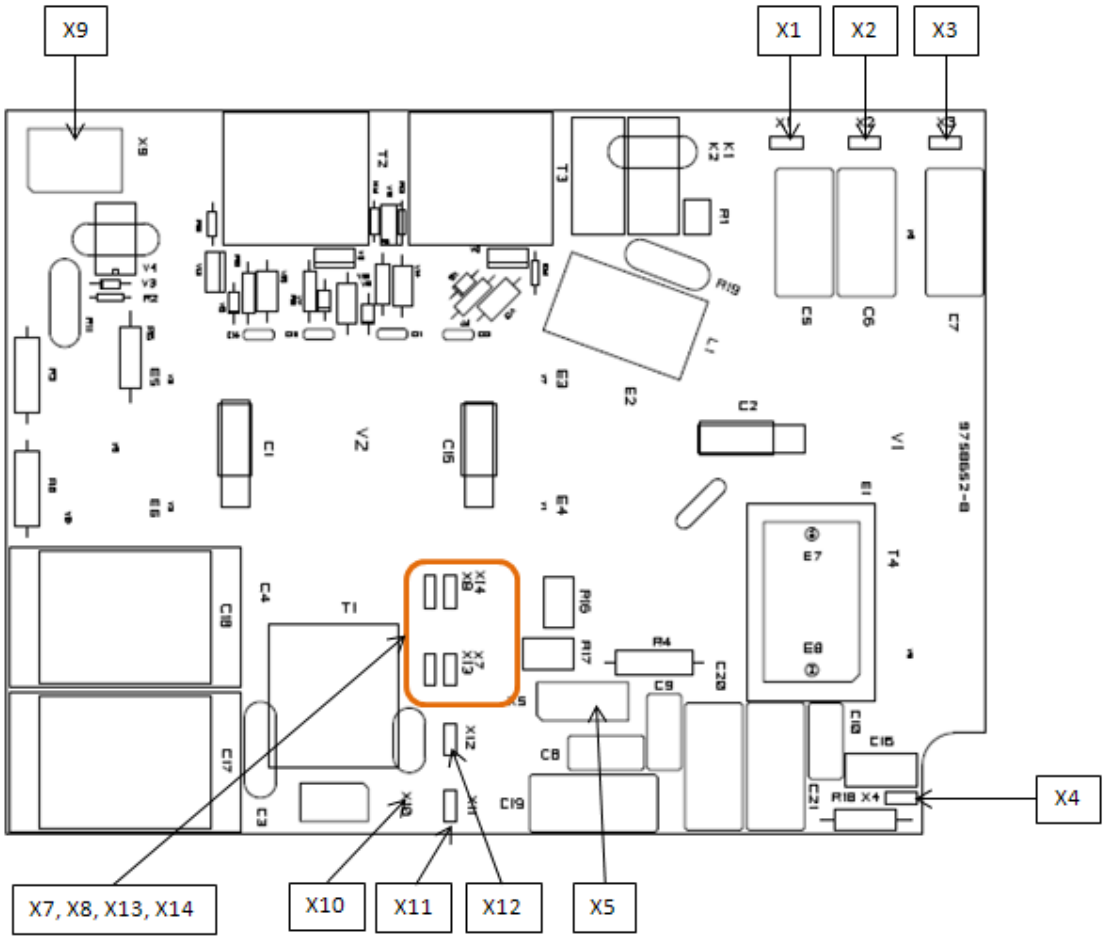
Pin	Signal
X9	PFC auxiliary voltage connector

Pin	Signal	Description
X10:1	Inrush Relay	Other end of the inrush relay coil
X10:2	OV Opto P	Over voltage optocoupler other end
X10:3	Primary current transformer	Primary current transformer other end
X10:4	Inrush Relay	Other end of the inrush relay coil
X10:5	OV Opto N	Over voltage optocoupler other end
X10:6	Primary current transformer	Primary current transformer other end
X10:7	IGBT Drive B	Other end of the IGBT driver transformer primary
X10:8	PFC ON/OFF P	PFC on/off opto coupler diode positive end
X10:9	-	-
X10:10	IGBT Drive A	Other end of the IGBT driver transformer primary
X10:11	PFC ON/OFF N	PFC on/off opto coupler diode negative end
X10:12	-	-

Pin	Signal
X11	PFC choke connections
X12	PFC choke connections
X14	PFC choke connections
X15	PFC choke connections

Pin	Signal
X13	DC-link voltage
X16	DC-link voltage

4.2. Kempact 253, 323



4.2.1. Connectors

Pin	Signal	Description
X1	Mains voltage	Main voltage connector
X2	Mains voltage	Mains voltage connector
X3	Mains voltage	Mains voltage connector

Pin	Signal
X4	Chassis ground connection

Pin	Signal
X5	Auxiliary transformer connection, auxliary transformer is protected with PTC resistors R16 and R17

Pin	Signal
X7	Main transformer connections (253 machine use two flat connectors, 323 use four)
X8	Main transformer connections (253 machine use two flat connectors, 323 use four)

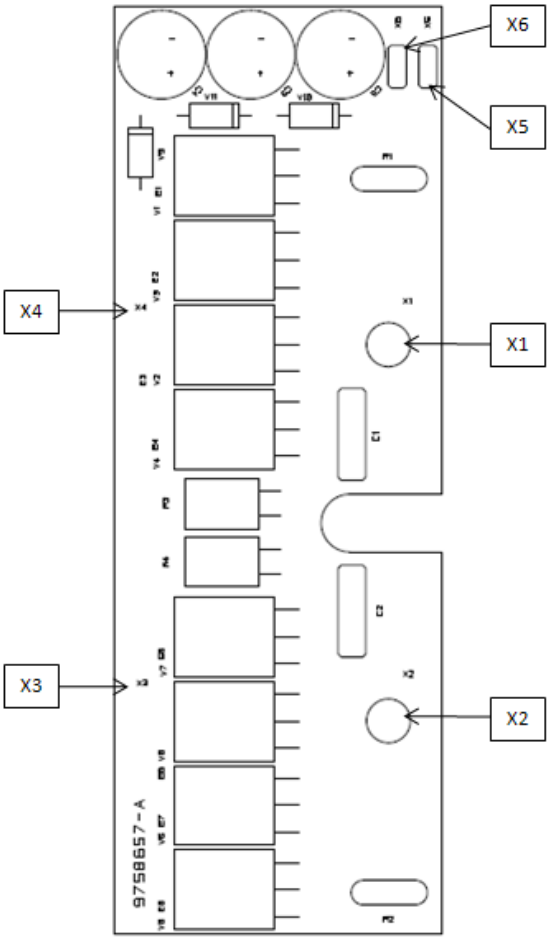
X13	Main transformer connections (253 machine use two flat connectors, 323 use four)
X14	Main transformer connections (253 machine use two flat connectors, 323 use four)

Pin	Signal	Description
X9:1	IGBT Drive B	Other end of the IGBT driver transformer primary
X9:2	OV Opto P	Over voltage optocoupler other end
X9:3	Inrush Relay	Other end of the inrush relay coil
X9:4	IGBT Drive A	Other end of the IGBT driver transformer primary
X9:5	OV Opto N	Over voltage optocoupler other end
X9:6	Inrush Relay	Other end of the inrush relay coil

Pin	Signal
X10	Primary current transformer connector

Pin	Signal
X11	DC-link voltage
X12	DC-link voltage

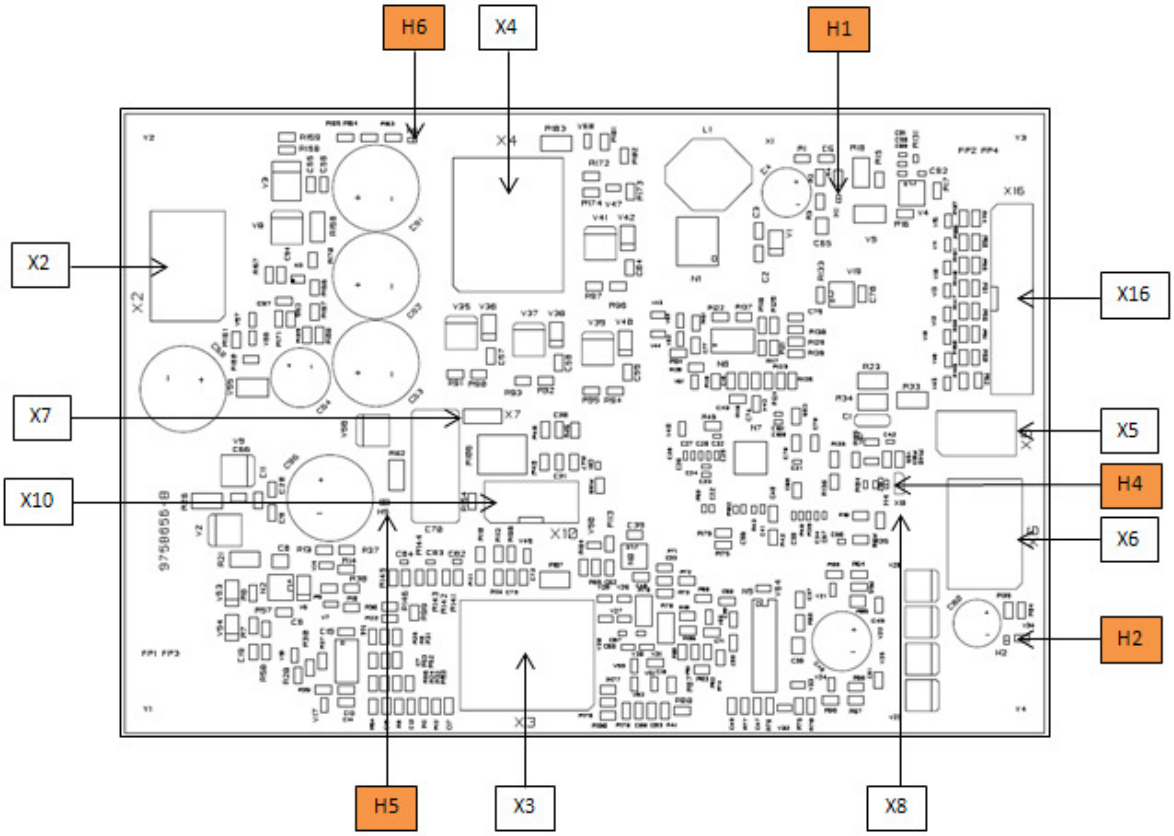
5. SECONDARY RECTIFIER CARD Z002



5.1. Connectors

Pin	Signal
X1	Main transformer secondary
X2	Main transformer secondary
X3	Z002 card connection to secondary profile
X4	Z002 card connection to secondary profile
X5	Rectified +24V
X6	Polarity connector (-)

6. CONTROL CARD A001



6.1. Leds

Led	Description
H1	Auxiliary voltage + 15V
H2	Status of IGBT driver, when this LED is lit IGBT driver is active
H4	RDI debug purposes
H5	Motor control input voltage
H6	+24V voltage

6.2. Connectors

Pin	Signal	Description
X2:1	+ 50 V	Secondary voltage from secondary card
X2:2	GND	Ground
X2:3	+ 24 V	+24V from the auxiliary transformer
X2:4	Motor (+)	Wire feed motor (+)
X2:5	Motor (-)	Wire feed motor (-)
X2:6	GND	Ground

Pin	Signal	Description
X3:1	Vout	Output voltage measurement from the dowel screw (+)
X3:2	CT (B)	Current transformer secondary (B).
X3:3	CT (A)	Current transformer secondary (A)
X3:4	GND	Ground
X3:5	GND	Ground
X3:6	J3	Primary current limit jumper.
X3:7	GND	Ground
X3:8	GND	Ground
X3:9	GND	Ground
X3:10	J2	Machine type jumper J2
X3:11	J1	Machine type jumper J1
X3:12	J0	Machine type jumper J0

Pin	Signal	Description
X4:1	Fan1 (-)	Fan 1 (-)
X4:2	Fan2 (-)	Fan 2 (-)
X4:3	Gas Valve	Gas valve
X4:4	Fan1 (+)	Fan 1 (+)
X4:5	Fan2 (+)	Fan 2 (+)
X4:6	Gas Valve	Gas valve
X4:7	Brights led (+)	Brights led card (P002) (+) connection.
X4:8	PFC control (+)	PFC ON/OFF control (+) connection
X4:9	Inrush relay	Inrush relay connection
X4:10	Brights led (-)	Brights led card (P002) (-) connection.
X4:11	PFC control (-)	PFC ON/OFF control (-) connection
X4:12	Inrush relay	Inrush relay connection

Pin	Signal	Description
X5:1	PRIM_OV_P	Primary over voltage alarm (+)
X5:2	PRIM_OV_N	Primary over voltage alarm (-)

Pin	Signal	Description
X6:1	PWM drive B	IGBT driver transformer other end
X6:2	PTC gnd	PTC ground connection
X6:3	Start B	Gun switch connection
X6:4	PWM drive A	IGBT driver transformer other end
X6:5	PTC	PTC connection
X6:6	Start A	Gun switch connection

Pin	Signal
X7	Connections to chassis ground

Pin	Signal
X8	Used in development purposes, do not connect anything here

Pin	Signal
X10	Maintenance use

Pin	Signal
X16	Panel card P001 connection

Pin	Signal
X19	Not in use

7. PANEL CARD P001

- Panel card is connected to the control card A001 connector with 16-wire ribbon cable

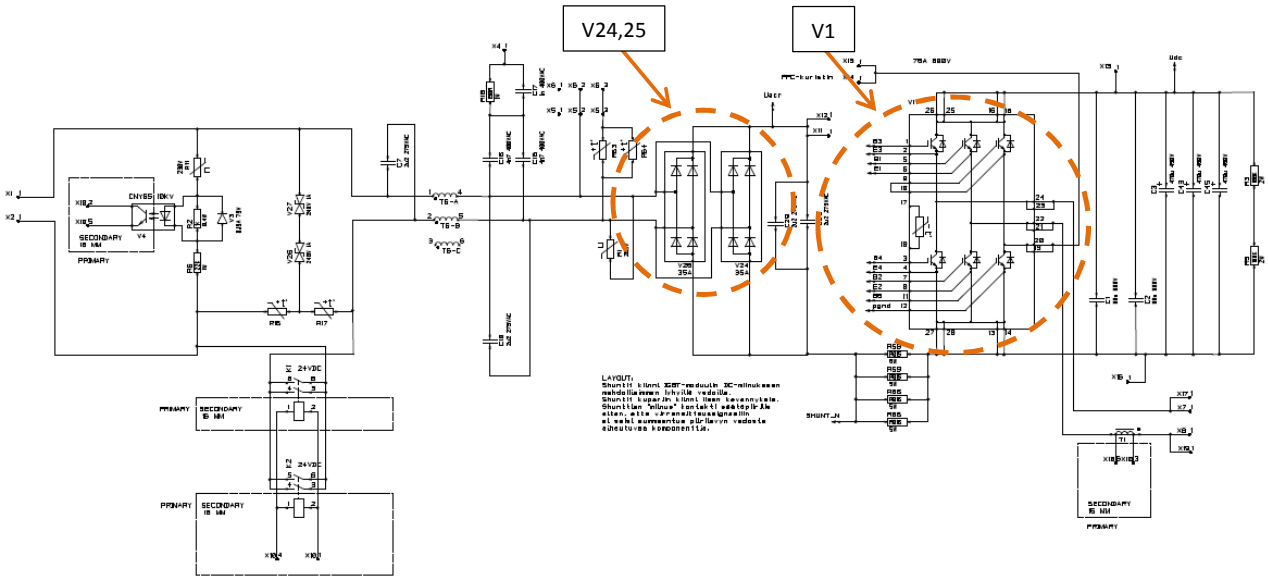
7.1. Connectors

Pin	Signal	Description
X1:1	+24V	+24V supply voltage for the LCD backlight
X1:2	SDA	I2C bus data
X1:3	+5V	+5V supply voltage
X1:4	GND	Ground
X1:5	SCL	I2C clock
X1:6	GND	Ground
X1:7	Pot_1_A	Pulse potentiometer 1 channel A
X1:8	Pot_1_B	Pulse potentiometer 1 channel B
X1:9	GND	Ground
X1:10	Pot_2_A	Pulse potentiometer 2 channel A
X1:11	Pot_2_B	Pulse potentiometer 2 channel B
X1:12	GND	Ground
X1:13	Pot_3_A	Pulse potentiometer 3 channel A
X1:14	Pot_3_B	Pulse potentiometer 3 channel B
X1:15	+5V	+5V supply voltage
X1:16	+24V	+24V supply voltage for the LCD backlight

8. OPERATIONAL MEASURINGS AND TESTS

NOTE !
Main supply voltage must *not* be connected when making measuring operations. The component frame has to be uninstalled so that main components conditions can be measured.

8.1. Kempact 181, 251



8.1.1 Primary rectifier V24, 25

- Primary side primary rectifier diodes can be measured one at the time
- Diodes must be measured both forward bias and reverse bias condition to make sure they are fine
- Check the diodes using the multimeter diode function to measure their threshold voltage 0,3…0,6 V

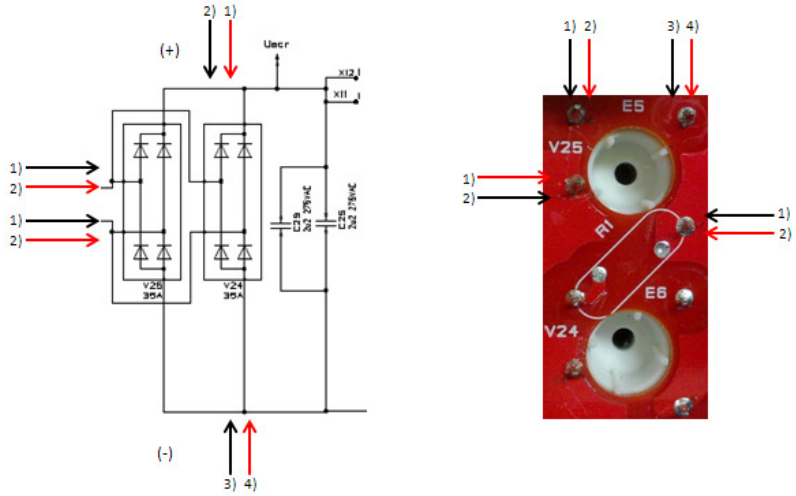
Measurings :
1) Positive test pole to rectifier pole (1, red), negative test pole to rectifiers poles (1, black) one at time
Result: 0,3…0,6→diodes Ok

2) Negative test pole to rectifier pole (2, black), positive test pole to rectifier poles (2, red) one at the time
Result: no value→diodes Ok

3) Negative test pole to rectifier pole (3, black), positive test pole rectifier poles (2, red)one at the time
Result: 0,3…0,6→diodes Ok

4) Positive pole to rectifier pole (4, red), negative test pole to rectifier poles (1, black) one at the time
Result: no value→diodes Ok

NOTE !
The measurement procedure is same for V24 and V25 rectifiers.

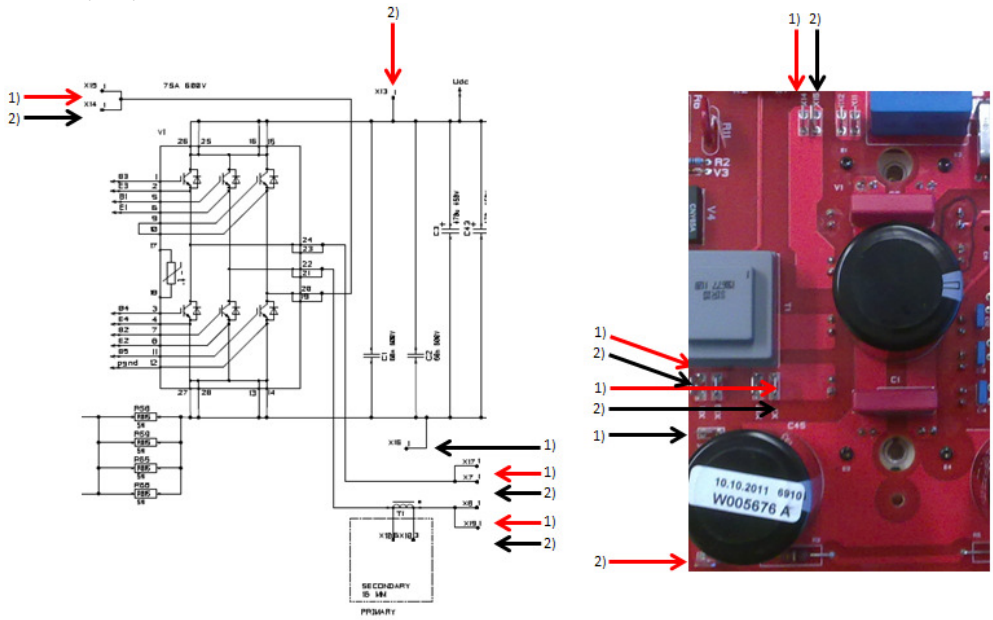


8.1.2. IGBT module V1

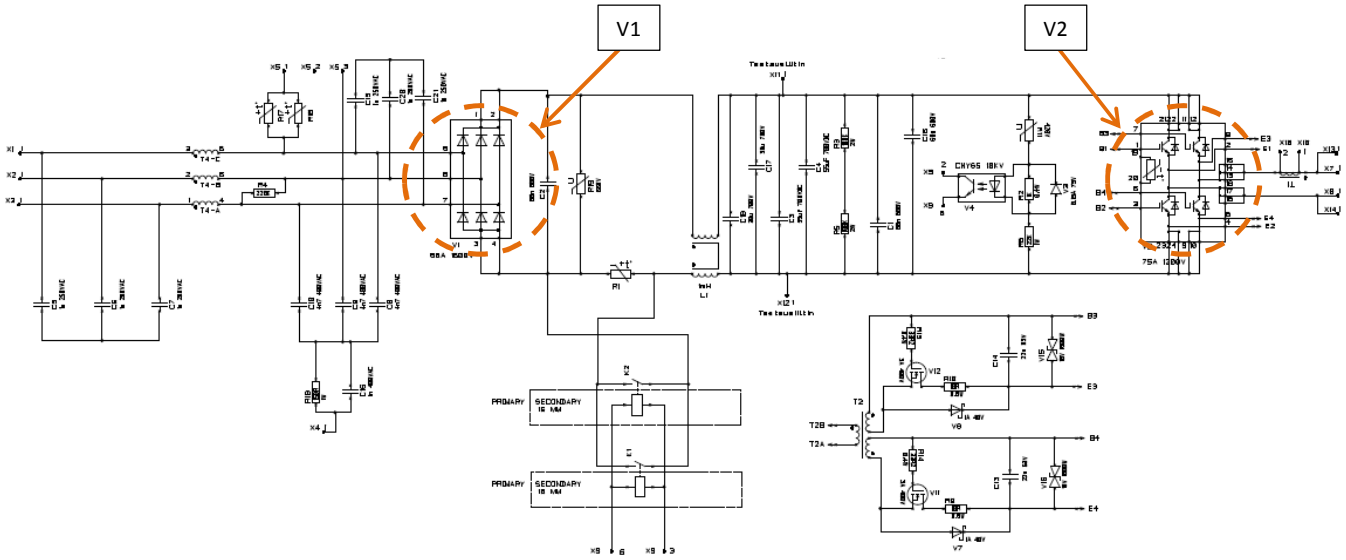
- IGBT module can be tested by multimeter if using the diode tester function. Module holds six diodes and in many cases they may be defective if IGBT is damaged
- When measuring IGBT unit diodes you must disconnect other end of main transformer (X7)
    - After measuring connect other end (X7) back

Measurings:
1) Negative test pole (1, black) to connector X16, positive test pole (1, red) to connectors X7, X8 and X14 one at time
Result: 0,3…0,6→diodes Ok

2) Positive test pole (2, red) to connector X13, negative test pole (2, black) to connectors and X7, X8 and X14 one at time
Result: 0,3…0,6→diodes Ok



8.2. Kempact 253, 323



8.2.1. Primary rectifier, V1

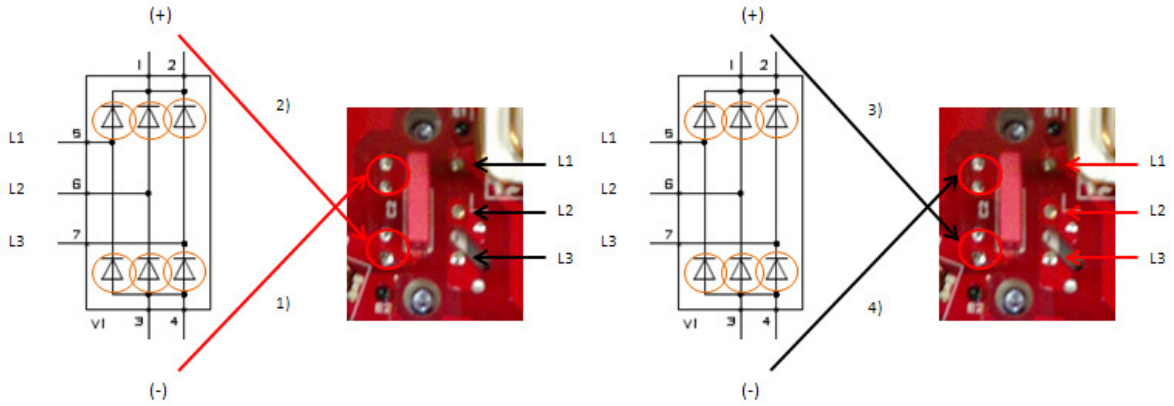
- Primary side primary rectifier diodes can be measured one at the time
- Diodes must be measured both forward bias and reverse bias condition to make sure they are fine
- Check the diodes using the multimeter diode function to measure their threshold voltage 0,3…0,6 V

Measurings:
1) Positive test pole to DC-link (-), negative test pole to L1, L2, L3 (one at the time)
Result: 0,3…0,6→diodes Ok

2) Positive test pole to DC-link (+), negative test pole L1, L2, L3 (one at the time)
Result: no value→diodes Ok

3) Negative test pole to DC-link (+), positive test pole L1, L2, L3 (one at the time)
Result: 0,3…0,6→diodes Ok

4) Negative test pole to DC-link (-), positive test pole L1, L2, L3 (one at the time)
Result: no value→diodes Ok

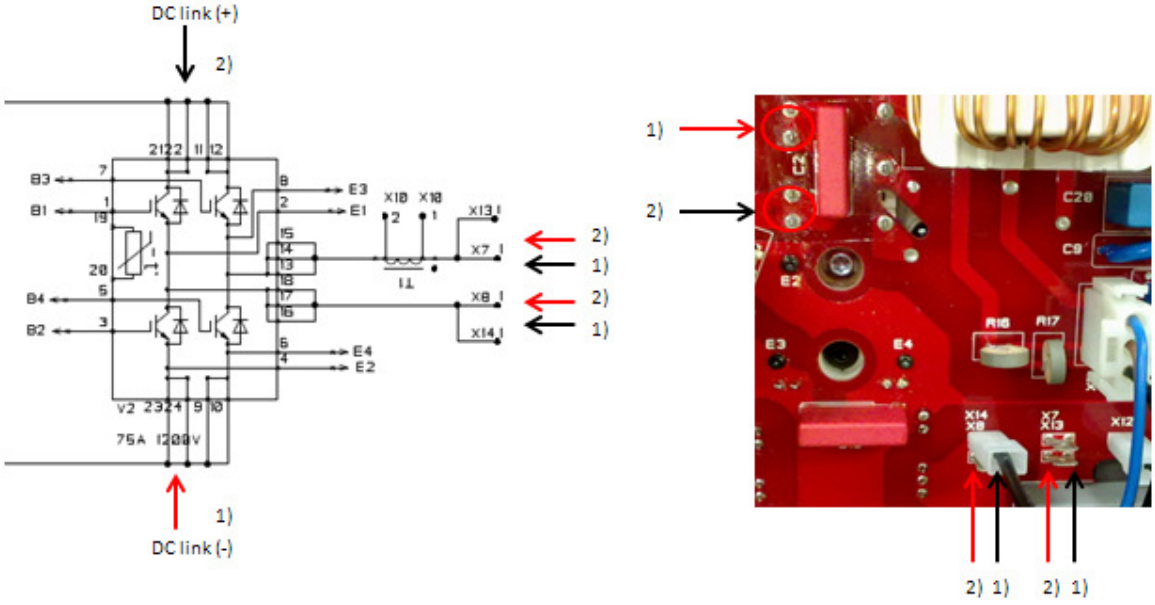


8.2.2. IGBT module, V2

- IGBT module can be tested by multimeter if using the diode tester function. Module holds four diodes and in many cases they may be defective if IGBT is damaged
- When measuring IGBT unit diodes you must disconnect other end of main transformer (X7)
    - After measuring connect other end (X7) back

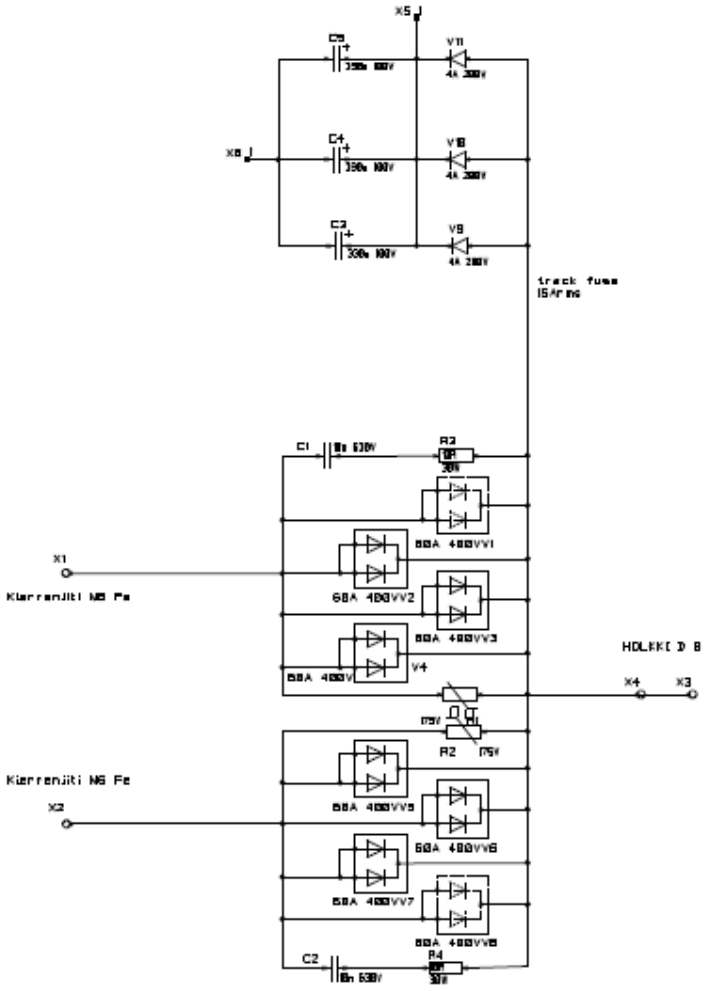
Measurings:
1) Positive test pole to connector X7 and X8 one at time, negative test pole to DC link (+)
Result: 0,3…0,6→diodes Ok

2) Positive test pole to DC-link (-), negative test pole to X7 and X8 one at time
Result: 0,3…0,6→diodes Ok



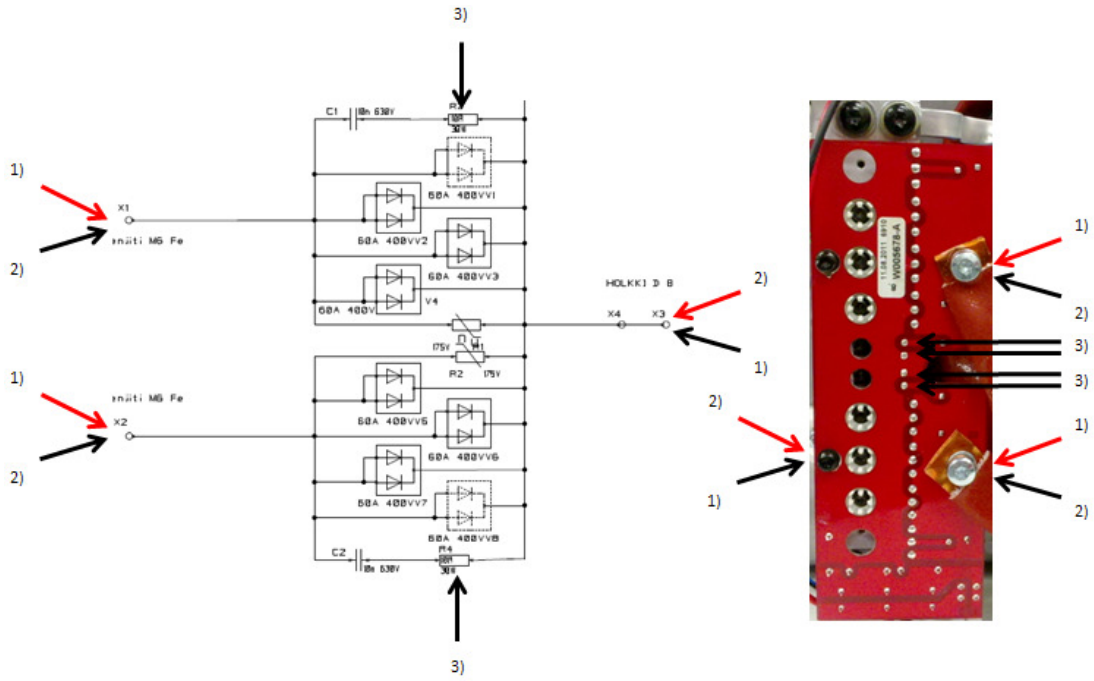
8.3. Secondary rectifier card, Z002

- Use a digital multimeter to test the secondary unit diodes. Diodes are in groups, so you can measure them in two separate groups



Measurings:
1) Positive test pole to main transformer secondary (secondary card connectors X1 and X2 one at time), negative test pole to secondary profile
Result: 0,3…0,6→diodes Ok

2) Positive test pole to secondary profile, negative test pole to main transformer secondary (secondary card connectors X1 and X2 one at time)
Result: no value→diodes Ok



3) Snubber resistors R3 and R4
Result: value ~10 Ω

8.4. PTC's, overheat protection

- There are two PTC's in machine
  - Main transformer Rt101 140 °C, value ~94 Ω in room temperature (connector 12, blue/white)
  - Secondary profile Rg201 90 °C, value ~63 Ω in room temperature (connector 11, green/green)
  - In over temperature situation PTC goes to high-resistance mode (>10kΩ)
  - A broken PTC has usually hundreds of kilo ohms resistance or no value at all

8.5. Control card A001

- Control card voltages can be quickly verified with LEDs on the control card A001

9. MAIN COMPONENTS INSTALLATION

- Heat sink paste should be spread on to the modules in an even layer by using clean fingers. Then the card should be immediately mounted onto the heat sink, this minimizes the possibility of any contamination (dirt etc.) getting between the components.
- Use torque screwdriver when tightening any power components onto the heat sink. See following sections for tightening torques.

9.1. Main circuit card Z001

- Primary rectifier V1 to heatsink 2 NM
- IGBT unit to heatsink
  - First step 2 NM and wait a couple minutes
  - Second step 3 NM
- Main circuit card Z001 to profile holder 0,7 NM
- Primary unit to component frame 2 NM

- Z001 grounding cable to component frame 5 NM

9.2. Secondary rectifier card Z002

- Secondary diodes to heatsink 1,2 NM
- Resistors to heatsink 0,7 NM
- Secondary card Z002 to heatsink 2,5 NM
- Secondary profile to component frame 2 NM
- Main transformer secondary leads 5 NM

9.3. Other components

- Main transformer T001 to component frame 2 NM
- Main transformer T001 secondary leads to secondary card Z002:X1,X2 5 NM
- Rectifier G003 to component frame 5 NM
- Auxiliary transformer T002 to component frame 5 NM
- Secondary choke L001 to component frame 2 NM
- Secondary choke L001 other lead to secondary profile 5 NM and other lead to polarity screw 5 NM

10. ERROR CODES

- In error situation welding is stopped and an error code is displayed on the panel
- The user can clear the error by pressing any of the panel buttons and if certain conditions are fulfilled
- If there are multiple errors at the same time only one can be displayed at a time. After user has cleared one error next is displayed and so on until there is no more errors

Error code	Error	Reason	Action / remedy
2	Mains under voltage	-mains voltage is under lower limit. -181 model: 195 V -251 model: 204 V -253, 323 models: 340V	-check mains voltage -mains over voltage error can be cleared after mains voltage has risen over low limit.
3	Mains over voltage	-mains voltage is over high limit: -181 model: 265 V -251 model: 276 V -253, 323 models: 460V	-check mains voltage -mains over voltage error can be cleared after mains voltage has fallen under high limit
4	Wire feed motor over current	-wire feed motor current (6 amps longer than 60 s) is too high -motor is jammed longer than 60 s	-this error can be cleared after welding has stopped due to this error -check wire feeding motor and mechanism
5	Wire feed motor control not calibrated	-calibration parameters have been corrupted -faulty control card A001	-start up machine (on/off) -change control card A001
6	Power source control not calibrated	-power source control calibration parameters are not in predefined limits -calibration parameters have been corrupted -faulty control card A001	-start up machine (on/off) - change control card A001
7	User interface memory error	-EEPROM memory error -used wrong welding parameters (improper value)	-start up machine (on/off) -check welding parameters
8	Memory channel 1 error	-memory channel data is invalid / corrupted	-start up machine (on/off) -check welding parameters
9	Memory channel 2 error	-memory channel data is invalid / corrupted	-start up machine (on/off) -check welding parameters
10	Memory channel 3 error	-memory channel data is invalid / corrupted	-start up machine (on/off) -check welding parameters
11	Memory channel 4 error	-memory channel data is invalid / corrupted	-start up machine (on/off) -check welding parameters
12	Continuous short circuit in the output of the power source	-there is continuous (over 2s.) short circuit in the output of the power source.	-remove short circuit from machine output (contact tip is connected / short circuited in welding piece)
100	Microcontroller error	-microcontroller reset. Possible reason: tig ignition spark.	-start up machine (on/off)
101	Microcontroller error	-microcontroller reset. Possible reason: flash memory has been corrupted	-start up machine (on/off)
102	Microcontroller error	-microcontroller reset. Possible reason: electromagnetic disturbance	-start up machine (on/off)
103	Microcontroller error	-microcontroller reset. Possible reason: electromagnetic disturbance	-start up machine (on/off)
110	Panel communication error	-communication error between panel card P001 and control card A001	-check flat cable/connectors between panel- and control card
111	Panel communication error	-communication error between panel card P001 and control card A001	-check flat cable/connectors between panel- and control card
112	Panel communication error	-communication error between panel card P001 and control card A001	-check flat cable/connectors between panel- and control card